Studies on the Utilization of Induced Mutation for Sugar Beet Breeding. (I)

Sensitivity of Sugar Beet to γ-Rays (Co^{60})

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Dry dormant seeds of sugar beet were irradiated with Co^{60} γ-rays of 40-1,000 kr in order to know the radiosensitivity of this plant as a first step to the utilization of induced mutation for sugar beet breeding, and it was found that even with the dosage of 300 kr the seed showed a high germination rate, although the seedlings irradiated with γ-rays of more than 70 kr gradually died in the process of development. This crop seems, therefore, to be highly resistant to γ-rays. Such a high resistance as this have been reported only in *Brassica napus* and *Sinapis alba* (Gustafsson, 1944).

From these results it was concluded that the dosage of γ-rays appropriate for mutation study in sugar beet is around 40 kr. In almost all varieties used the plants which developed from the irradiated seeds showed a slower growth than the controls. No difference was observed between diploid and polyploid varieties in the radiosensitivity.

INTRODUCTION

Although a large number of studies have been carried out on the induced mutation in crop plants, no investigations have been reported in sugar beet. In view of this status, the present authors initiated a study on the induced mutation in sugar beet with the aim of developing a variety fitted for the southwestern district of Japan, in which no variety is grown because of the comparatively high temterature. The purpose of this paper is to report the radiosensitivity of sugar beet as a preliminary investigation of the study.

MATERIAL AND METHOD

Dormant seed of variety Hon-iku No. 192 was irradiated with Co^{60} γ-rays of 40-1,000 kr to know the appropriate dose that might be applied to sugar beet without decreasing viability, and then the seeds of 14 varieties were irradiated with the 40 kr γ-rays. Thereafter, the vigor of the irradiated material was compared with that of the control.

RESULTS

The seed of Hon-iku No. 192 showed a high germinating ability even at 300 kr but this gradually decreased with more than 500 kr and the germination was considerably prolonged (Table 1). The seedlings, however, showed a weak

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Table 1. Germination rate after irradiation of γ-rays (1958)*.

Dosage (kr)	Control	40	50	70	100	250	300	500	1000
Germination rate (%)	67.0	69.5	66.0	65.0	62.0	59.5	57.5	46.5	5.0

* In this test Honiku-No. 192 was used.

growth with more than 1,000 kr and died within 3-4 weeks after germination. Further, at 70 kr the plant had grown normally in the early stage of development but in the later almost all of them gradually died.

These results indicate that sugar beet is remarkably high-resistant to ionizing radiation compared with other crops. Such a high resistance as this have been reported only in *Brassica napus* and *Sinapis alba* (Gustafsson, 1944). It may also be concluded that the appropriate dosage for mutation study in sugar beet is around 40 kr.

Taking note of these results, the seeds of 14 varieties were exposed to γ-rays of 40 kr and plant height of the seedlings was measured as an index of radiosensitivity at 6 and 16 weeks after sowing (Table 2). As will be seen from Table 2, plant height is generally lower in the irradiated material than in the control at both stages of development examined.

Table 2. Plant height of the irradiated sugar beet (1959).

Varieties	Dosage (kr)	6 weeks after sowing (cm)	16 weeks after sowing (cm)	Varieties	Dosage (kr)	6 weeks after sowing (cm)	16 weeks after sowing (cm)
Diploid varieties				KL-CR	Cont.	3.10	34.31
Honiku No. 192	Cont.	5.10	38.00		40	3.42	32.72
〃	40	4.06	32.18	202 H	Cont.	3.51	33.53
Gw 443	Cont.	4.19	31.10		40	3.99	34.53
〃	40	4.18	28.50	Triploid varieties			
Gw 359	Cont.	4.19	28.84	Polybeta B_1	Cont.	3.89	19.07
〃	40	3.16	29.44	〃	40	3.74	17.19
Us 216	Cont.	3.02	24.27	Polybeta B_2	Cont.	4.29	34.50
〃	40	2.77	32.22	〃	40	4.01	20.33
Eagle Hill Brand	Cont.	2.99	33.58	KL-cercopoly	Cont.	4.28	37.36
〃	40	3.20	31.09	〃	40	3.84	33.49
Cesena NSA	Cont.	2.86	30.24	Tetraploid varieties			
〃	40	2.20	27.47				
Aj 1	Cont.	2.85	36.44	Hilleshög polybeta	Cont.	3.55	33.88
〃	40	2.88	42.78				
PL-AA	Cont.	4.07	40.06	〃	40	3.32	22.59
〃	40	2.56	35.53				

Comparison of the diploid and polyploid varieties shows no difference in their radiosensitivity. This is in accordance with the result obtained by Fujii (1958) with *Triticum* and *Aegilops*.

The types of mutation (special attention will be drawn to disease resistance

and sugar content) and mutation rate of each type are now on the program of investigations to be followed.

REFERENCES

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